the depression being over northern Texas. Southeast storm warnings were displayed on the Louisiana coast and southwest warnings on the east coast of Texas. As the disturbance tended to fill up and diminish in intensity, the warnings were not verified.

On the morning of the 26th an area of high pressure was advancing southeastward from the Rocky Mountain region and the Plains States, preceded by low pressure in the lower Mississippi Valley and on the Texas coast. Northwest storm warnings were ordered for the Texas coast and were verified.

Small-craft warnings were displayed on the Louisiana coast on the 1st, 4th, and 6th, and on the Texas coast on the 6th and 17th, and were justified.

No general storm occurred without warnings.

On April 1 and 2, a disturbance moved northeastward from the southern Plains States to the Lake region and was followed by frost in northern Texas as far east as Dallas, with freezing in northwestern Texas and Oklahoma. Warnings of frost or freezing temperature were issued 24 hours in advance of occurrence for the northwestern portion of the district, but for not quite all the area where frost occurred, the movement of the conditions being unusually rapid for the season.

On account of intense conditions on the morning of the 3d, when a disturbance overlaid the northwestern portion of the district, with a strong barometric gradient on the northern side, freezing was forecast for Oklahoma, the northern portion of west Texas, the northwestern portion of east Texas, and northern Arkansas. Midday special observations were obtained and a cold-wave warning was issued for the northwestern portion of the district. The warning was verified and freezing weather occurred as forecast. A minimum temperature of 13° was registered at Amarillo on the 4th.

Warning of frost in the interior of Louisiana and to the Texas coast except in the lower Rio Grande Valley, with freezing or lower in Oklahoma, northern Texas, Arkansas, and extreme northern Louisiana, was issued on the morning of the 4th. Conditions occurred generally as forecast. Frost was observed as far south as Houston, Tex., on the morning of the 5th, and the lowest temperature of record for the season occurred at Galveston, Tex., Shreveport, La., and in Arkansas.

On the morning of the 11th a deep depression was central over extreme southwestern Kansas and a moderate area of high pressure to the northward was moving south. Cold-wave warnings were issued for the northwestern portion of the district. The cold wave reached the Texas Panhandle on the morning of the 12th, but freezing did not extend over southern Oklahoma, and did not reach Bentonville, Ark., until the morning of the 13th.

Besides the warnings already mentioned, warnings of frost or freezing temperature in some portion of the district, in the northern portion as a rule, were issued on the 5th, 6th, 9th, 11th, 13th, 17th, 18th, 22d, 25th, 26th, 27th, and 30th, and nearly all were verified. Warnings to live-stock interests were issued on the 3d, 11th, and 17th for the northwestern portion of the district.

Fire-weather warnings for the forest reserves of Oklahoma and Arkansas were issued on the 3d, 14th, 17th, and 21st, and were fully justified, the wind and weather occurring as predicted in nearly every particular.—*R. A. Dyke.*

San Francisco Forecast District.—No severe storms occurred in this district during April. Sufficient rain fell for present needs, though the amount was below normal in California and the greater part of Nevada. In the North Pacific States it was heavier than usual and in the lower Columbia River Valley the excess amounted to more than an inch.

There were two wet spells in California and Nevada, both of which covered a period of about three days. The first began on the 8th and was caused by a LOW over western Oregon that moved southeastward. The second, beginning on the 13th, was from a LOW over British Columbia that moved south to Nevada, where it developed sufficient intensity to cause well distributed showers in the southern portion of the district.

During these two wet spells a large amount of snow was deposited in the northern Sierra Nevada Mountains. This was just what was needed to improve the water supply for irrigation and power purposes, as before it fell the snowfall was far below normal and even now it is considered insufficient for all requirements during the latter part of the summer.

After the showery period near the middle of the month, the weather in this district was controlled by the North Pacific HIGH, which was most in evidence along the coast north of Eureka, Calif. Near the close of April a LOW from British Columbia moved south to Nevada, but it did not develop sufficient energy to cause any precipitation of consequence in the southern portion of the district.

Storm warnings were issued on the 2d and 3d for the North Pacific coast, and quite frequently between the 8th and 19th along the north California coast for winds that were more local than general in character. Small-craft warnings were displayed at San Francisco on the 15th. It is thought the storm warnings were timely and of benefit to mariners.

During the forepart of the month frost warnings were issued for the interior of northern California on several occasions, and during the latter half they were issued quite frequently for different localities in the North Pacific States. It is believed they were all justified and that no damaging frosts occurred without warnings.

Live-stock warnings for cold rains, with snow in the mountains, were distributed to stockmen on the 19th and 29th, both of which it is believed were fully verified.—*E. A. Beals.*

RIVERS AND FLOODS, APRIL, 1920.

ALFRED J. HENRY, Meteorologist in Charge River and Flood Division.

[Weather Bureau, Washington, June 2, 1920.]

FLOODS, APRIL, 1920.

This report deals with floods which began in March and continued into April. (See this REVIEW **48:** 176–178.

Floods in New England.—The melting of the heavy snow cover in New England in connection with the current precipitation of the month produced high water of more than the usual duration. The Connecticut at Hartford was above flood stage from the 1st to the 9th and again from the 14th to the 21st, and finally from the 22d until the close of the month. The Merrimac reached a stage of 21.68, the highest since 1902.

Frequent light floods in the rivers of the Carolinas served to prolong high water in the lower reaches

of the streams in those States, particularly in South Carolina.

Moderate floods also prevailed in the rivers of Georgia and Mississippi, due to frequent short periods of rain. The distinctive feature of these floods was the sustained high water and in places the overflow of bottom lands as in the Tombigbee Valley from near Demopolis to the mouth of the river and in the Black Warrior Valley below Tuscaloosa. At the close of the month considerable portions of the lowlands along the Tombigbee remained flooded.

There were no floods of importance in the West Gulf Drainage.

Great Lakes Drainage.—The only flood of importance in this district occurred in the Maumee and its tributaries during the period April 21–24. There was no serious damage.

Mississippi Basin—Ohio Drainage.—On the 1st the rainfall was general and more or less heavy over the watershed of the Cumberland and the Tennessee. The rain continued on the next day and was also general and much heavier, averaging more than 3.5 inches above Decatur, except in the northern headwater streams, where it was about 2.25 inches. As a result the Tennessee above Decatur rose sharply on the 2d, the rise continuing and increasing on the 3d; on this date the crest of the upstream rise passed Knoxville and Loudon. No rain fell on the 3d, but on the 4th moderate rains again fell over the watershed above Decatur.

On the morning of the 2d the official in charge of the Chattanooga district issued warnings for his entire district. The crest stage for Chattanooga was tentatively placed at not less than 41 feet, and the city commissioner of fire and police for Chattanooga was advised that immediate action should be taken looking to the removal of the people living below the 41-foot mark on the gage. This was done and a general distribution of the warning was made by means of bulletin, publication in the city papers, and personal replies by telephone.

The river at Chattanooga rose from 17.2 feet on the 1st to a crest of 43.6 feet at 9 a. m. of the 5th, 26.4 feet in a little more than four days. This rise passed slowly downstream, flattening out in the lower reaches so that when the Ohio was reached the increased flow from the Tennessee was not sufficient to check the fall which had already set in in the trunk stream.

The more or less heavy rains of the 20th–26th caused the northern tributaries to reach and pass flood stage. Earlier in the month the Tennessee and Cumberland had been in flood, but at no time did the flood waters from both north and south tributaries synchronize. The principal flood in the Ohio was that of the 22d–25th in the lower reaches of the stream. The river at Cairo was at a stage of 51.1 feet on the 1st and did not fall below flood until the 19th, remaining below only six days, when it again rose to above flood stage, due to the rains of the 19th–21st and continued above flood stage at the close of the month. Floods in the lower Ohio have been usually frequent during the last six months.

The April high water along the lower Ohio seriously delayed the planting of the lowlands to corn.

Mississippi Main Stream.—At the close of March the Mississippi was in flood from Winona, Minn., to La Crosse, Wis., also from Quincy, Ill., to Helena, Ark. At the close of April the river was above the flood stage from New Madrid, Mo., to the mouth, and also in the stretch between Hannibal, Mo., and Alton, Ill.

The flood in the upper Mississippi which was in progress on April 1 was due to a heavy discharge from the rivers of Minnesota and Wisconsin, augmented by moderately heavy rains during the first few days of April. Timely warnings were issued by the Weather Bureau officials along the stretch of river concerned, thereby enabling precautionary measures to be taken and the removal of property from the threatened areas. Below is a condensed summary of the flood in the Dubuque and Davenport, Iowa, and Hannibal, Mo., districts:

FLOOD OF MARCH-APRIL, 1920, DUBUQUE, IOWA, DISTRICT.—This Mississippi flood was the worst in this district since 1888, and has been exceeded in the last 50 years only by the floods of June, 1880, and May, 1888. It was the earliest spring flood of such magnitude of which there is a record. In rapidity of rise it is comparable with the flood of June 1880. The total rise in each of these two floods between 13 and 14 feet continued over a period of more than two weeks.

In the flood of June, 1880, the maximum rise was 6 feet in three days, while in the 1920 flood the maximum rise was the same, with this important difference, viz, it came during the last part of the rise instead of the first part, as in 1880.

Most of the flood waters came from the headwaters of the Mississippi. The Wisconsin River was above flood stage during the same period, a maximum stage of 15 feet being recorded at Portage on March 31. This flood added about 1.5 feet to the peak of the Mississippi River flood between Dubuque and Prairie du Chien. Heavy and general rains on April 1 also added 0.5 or 0.6 feet to the peak between Prairie du Chien and La Crosse. With these exceptions the flood waters came wholly from the region north of La Crosse.

In two particulars the floods of June, 1880, and March-April, 1920, were not comparable. The cause in 1880 was exceedingly heavy rains early in June over the headwaters of both the Mississippi and Wisconsin Rivers. The cause in 1920 is probably indicated by the following paragraph from the National Snow and Ice Bulletin, Minnesota report, March 23, 1920: "Latter part of week abnormally warm and snow disappearing rapidly." Warm weather, the disappearance of snow in northern Minnesota, and the appearance of the flood at St. Paul were almost simultaneous. From Prairie du Chien to La Crosse the flood peak in 1880 was much higher than in 1920, but at Dubuque it was only 0.7 of a foot higher. The following table illustrates the difference:

	La Crosse.	Lansing.	Prairie du Chien.	Dubuque.
Peak, June, 1880	16.2	.....	21.5	21.7
Peak, March-April, 1920	14.2	17.2	19.6	21.0
Difference	2.0	.....	1.0	0.7

WARNINGS.—On Monday, March 29, nine days before the peak of the flood reached Dubuque, flood warnings were issued for the entire district from the vicinity of Dubuque to immediately below La Crosse. On this date stage of water was 11.5 feet at Dubuque, 10.8 feet at Prairie du Chien, and 11.3 feet at Lansing. Warnings were generally heeded, and movable property, such as cordwood in large quantities, live stock, farm machinery, etc., was removed from the islands and lowlands of the Mississippi throughout the section.

Later in the week, when it became certain that a flood of great magnitude was approaching, whatever could be done to prevent damage was done. Upon advice from this office some of the factories raised machinery to higher levels, and a number of firms within the wholesale district of Dubuque removed their stocks from cellars and basements.

This office was able to render valuable service over more than a 10-day period. Information was given daily over the phone to several hundred people. On Sunday, April 4, the office was open from 6 a. m. until 10 p. m., and the phone was in use every moment of the time. We were able to advise many families not to move and many business houses not to move stocks or machinery after ascertaining how many inches more of a rise they could stand. On this date a northeasterly gale added to the difficulties of the railroads on the west bank of the Mississippi. After that date winds were generally more favorable.—*J. H. Spencer.*

DAVENPORT DISTRICT.—The rapid melting of an unusually heavy accumulation of snow in Minnesota and Wisconsin, most of which remained on the ground until about the middle of March, when it was taken off quickly by the high temperatures and heavy rains that attended a succession of storms that moved across the upper Mississippi watershed during the latter half of the month and the first day or two of April, resulted in the highest stages in the Davenport River district since the year 1892.

On March 31 the following flood warning was issued: "The Mississippi will reach or exceed the flood stage within the next week or 10 days at all points between Dubuque and Muscatine. Approximately the fol-

lowing maximum stages are now indicated: Clinton, 17 feet, April 8; Le Claire, 11.5 feet, April 9; Davenport, 15 feet. April 9; Muscatine, 16.5 feet, April 10. All threatened property should be removed or protected."

The flood crest reached all stations in the district on the dates named in the forecasts, with the following highest stages: Clinton, 19 feet; Le Claire, 13.4 feet; Davenport, 17.1 feet. A break in the levee at Muscatine, 12 miles below the city, occurred during the night of April 6–7, when the stage was approximately 17 feet. About midnight of the 8th–9th a break occurred on the Illinois side, opposite Muscatine, when the gage reading was 18 feet, and the stage fell 0.3 foot, or to 17.7 feet, by 7 a. m. of the 9th, and to 17.5 feet at 7 a. m. of the 10th. At noon of the 10th the stage had again risen to 17.7 feet, when further breaks in the levees on the Illinois side caused a fall of 0.7 foot during the next 18 hours, the gage reading 17 feet at 7 a. m. of the 11th.

Within a day or two after the arrival of the flood crest, the river began to fall at a moderately rapid rate, passing below the flood stage at Clinton on April 15, at Le Claire by the 18th, at Davenport on the 14th, and at Muscatine on the 16th.

Immediately after the first flood warning was issued a large force of men was employed at Bettendorf, Iowa, about a mile above Davenport, in strengthening the levees at that place which protect the large plants of the Bettendorf Co. and the Zimmerman Steel Co. For about a week before the arrival of the flood crest work in the factory of the Bettendorf Co. was suspended and the forces of men from the shops were engaged continuously, day and night, in preparing the levees to withstand a 17-foot stage. These efforts were successful, the loss being confined to that due to suspension of business.

On account of the accurate warnings issued well in advance, losses from Clinton to Davenport, inclusive, were comparatively small, practically all movable properly having been placed out of danger. Considerable inconvenience was caused by the flooding of cellars near the river front with seep water, which in some cases rendered heating plants useless, and dwellers in the poorest class of houses along the water front were compelled to abandon their homes.

Notwithstanding the heavy losses to agricultural interests in the bottom lands on both sides of the river near Muscatine, caused by the failure of the levees to hold, the strenuous efforts which were begun when the first flood warning was issued to maintain the levee that protected the city itself were successful, the damage within the city limits not exceeding $50,000, due, mostly, to suspension of business.

Opposite Muscatine, in Illinois, about 62,800 acres of exceptionally rich agricultural land were flooded in the Drury, Union, Bay Island, and No. 13 drainage districts by the breaking of the levees, while 23,000 acres of land, mostly devoted to truck raising, were flooded on Muscatine Island, immediately below the city. Although the total loss in those sections, including the loss of prospective crops, will exceed $3,500,000, only about $18,400 worth of movable property was destroyed, of which there was $5,000 worth of corn that had been left in the shock.

It is now thought that it will be impossible to plant the flooded lands on the Illinois side and that the loss to prospective crops will amount to $50 per acre. On Muscatine Island, where the natural drainage is much better, the loss will be only partial and will hardly exceed $10 per acre.—*J. M. Sherier.*

HANNIBAL DISTRICT.—The melting snow and rains during the last half of March caused a slight flood in the lower Des Moines River and the beginning of a severe flood in the Mississippi.

Advisory warnings for the territory from Ottumwa to Alexandria were issued on March 16 and again on March 25 and 26. Warnings for the reach from Keokuk to Louisiana were issued on March 25, and for Keithsburg on March 30. Warnings for some portion of the sistrict were issued on April 2, 3, 5, 6, 7, 8, 9, 10, 11, 21, and 22.

During the period from April 2 to 13 forecasts from three to six days in advance were made and were verified to within 0.1 to 0.3 of a foot. The only material failure was caused by the breaking of two levees near Muscatine, Iowa, which caused a delay in the flood wave and a lessening of crest stages for some distance below the break.

The flood seemed to be over by April 17, when heavy rains on April 18 and 19 in northeastern Missouri, the Des Moines, Skunk and Cedar valleys in Iowa, caused more serious flood conditions from Quincy to Louisiana than had occurred from the flood waters of the upper Mississippi River.

There was no preventable loss.—*B. L. Waldron.*

While the Mississippi in the St. Louis district reached and passed slightly above the flood stage at Grafton, Alton, and Chester, Ill., no material damage was caused. The river was in flood at Cairo and below from the discharge of the Ohio as before stated. At Memphis the crest of the first rise, 40.3 feet, was reached on the 5th; then followed a slow decline to 35 feet on the 25th and 26th, only to be followed by another rise which continued into May.

At Vicksburg the river passed above flood stage on the 4th with a crest of 50.8 feet on the 20th. At the close of the month the river was almost stationary and above the flood stage. At this writing (June 1) it is at a stage of 48.3 feet and falling slowly.

NEW ORLEANS DISTRICT.—On March 24, when the river stage at Cairo was 48.5 feet, and at Natchez was 35.6 feet, the first warning for the Mississippi below Vicksburg was issued, stating that the flood stage, 46 feet, would be passed at Natchez by April 10. On March 30, warning was issued that the flood stage would be passed also at Baton Rouge, Donaldsonville, and Melville by April 10. On April 1 the following warning was issued:

"The Mississippi River below Vicksburg, and the Atchafalaya, will rise until the latter part of April. Water now in sight indicates at least the following stages: Natchez, 49.5 feet by 20th; Baton Rouge, 37.5 feet, and Melville, 39 feet by 22d; Donaldsonville, 29.5, New Orleans 18 feet and Simmesport, 41 feet by 24th."

This warning was modified from time to time as the current weather conditions demanded. The flood is still in progress.—*I. M. Cline.*

Agricultural Lands Overflowed.—The greatest single overflow was due to the failure of two levees—one on the Illinois side of the Mississippi opposite Muscatine, Iowa, the other on the Iowa side and also opposite Muscatine. About 86,000 acres were overflowed as a result of these breaks.

All of the lowlands between Keokuk and Hannibal not protected by levees were overflowed.

There was also considerable overflow in Pike, Knox, and Daviess Counties, Ind., along the lower White River and along the Ohio in the Evansville, Ind., district. Some damage was done the oat and wheat crop in Indiana. A levee north of Vincennes, Ind., broke on April 3, flooding about 10,000 acres of bottom lands. Bottom lands were also overflowed in western Alabama.

High water in the Mississippi coupled with freshets in the Ouachita and Red Rivers made conditions along the lower Black River of Mississippi critical on account of backwater.

The only break in the levees protecting the lowlands along the lower Mississippi River occurred on the 17th about 75 miles below New Orleans. This break was promptly repaired.

HEAVY RAINS AND FLOODS IN BLACK HILLS, S. DAK.

Rain began Monday afternoon May 10, and was almost continuous until Wednesday night, May 12, which, following the unprecedented snowfall of April 17 and 18, caused the greatest floods in Rapid Creek—a tributary of Cheyenne River—since 1907, and all streams in the Black Hills region were at flood stages. The total rainfall at Rapid City for the period, 10th to 12th, was 4.75 inches.

As a result of the melting of heavy snows and the moderate rainfall during the first part of May the creek was approximately 3½ feet above the normal on May 10, at which time it began rising. By Tuesday morning, May 11, the water had spread over the low flats and the conditions were fast becoming serious. Due to the heavy fall of rain during the night and morning of May 11, telephonic reports from upstream indicated that the river was steadily rising, and at 9 a. m. the Weather Bureau observer issued warnings to the city authorities to prepare for a further rise of 2 feet, or a stage of 6 feet above the normal, and that conditions were dangerous to people living on the lowlands. These people were immediately notified and removed from their homes. The crest of the flood reached Rapid City about noon May 11 and the stage of water was approximately 6 feet above the normal. Many homes were surrounded by water but no lives were lost.

About 20 bridges on the Rapid City, Black Hills & Western Railroad were either damaged or washed out, and practically all the private and county bridges on the stream were taken out. Other railroads suffered in like manner. It is estimated that from $75,000 to $100,000 will be required to put the railroads in good condition aside from loss of service from two weeks to a month. Six persons lost their lives in this flood outside of Rapid City.—*H. N. Johnson.*

Estimated loss by flood, April, 1920.

River and district.	Tangible property—Bridges, roads, buildings, etc.	Crops. Matured.	Crops. Prospective.	Suspension of business.	Farm buildings, machinery, live stock, etc.	Estimated value of warnings.
Mississippi.						
Hannibal district	$5,500	$3,000	$50,000	$800	.....	$62,000
Davenport district	136,040	8,500	3,371,800	185,775	$85,900	2,501,300
Dubuque district	88,000	1,000	500	5,500	5,000	125,000
White (Ind.):						
Indianapolis district	15,000	2,000	25,000	10,000	.....	(1)
Wabash:						
Terre Haute district	2,000	.....	200,000	2,500	.....	100,000
French Broad:						
Asheville district	32,000	5,000	500	600	1,000	.....
Santee:						
Columbia district	550	.....	.....	600	.....	60,000
Peedee:						
Charleston district	5,000	.....	.....	.....	.....	.....
Pearl and West Pearl:						
Meridian district	4,000	1,000	750	2,000	1,000	5,000
Alabama:						
Montgomery district	.....	1,050	.....	1,100	300	7,000
Cumberland:						
Nashville district	.....	.....	5,000	15,500	.....	10,500
Hudson:						
Albany	300	.....	.....	.....	.....	500
Total	288,390	21,550	3,656,550	224,375	93,200	2,815,500

(1) Unknown.

Flood stages for the month of April, 1920.

River and station.	Flood stage.	Above flood stages—dates. From—	Above flood stages—dates. To—	Crest. Stage.	Crest. Date.
ATLANTIC DRAINAGE.					
Connecticut:	*Feet.*			*Feet.*	
White River Junction, Vt.	13	(2)	7	17.6	[2] 26
Do	13	14	(1)	18.4	24
Hartford, Conn.	16	(2)	9	22.5	[2] 30
Do	16	15	(1)	20.2	16
Albany:					
Hoosick Falls, N. Y.	3	10	11	3.1	10,11
Susquehanna:					
Oneonto, N. Y.	12	1	4	12.8	1,3
Neuse:					
Neuse, N. C	14	29	29	14.2	29
Peedee:					
Cheraw, S. C.	27	6	7	28.0	5
Santee:					
Rimini, S. C.	12	(2)	(1)	17.2	9,10
Ferguson, S. C.	12	(2)	(1)	14.0	3
Catawba:					
Catawba, S. C.	12	3	3	12.2	3
Wateree:					
Camden, S. C.	24	5	7	26.6	5
Broad:					
Blairs, S. C.	15	6	6	15.2	6
Saluda:					
Pelzer, S. C.	7	6	6	7.6	6
Edisto:					
Chappells, S. C.	14	(2)	1	17.0	[2] 31
Do	14	3	7	15.5	6
Edisto, S. C.	6	2	6	6.4	4,5
Broad (Ga.):					
Carlton, Ga.	11	2	2	11.0	2
Ocmulgee:					
Abbeville, Ga.	11	2	13	14.7	4
Lumber City, Ga.	15	6	12	16.8	7
EAST GULF DRAINAGE.					
Apalachicola:					
Blountstown, Fla.	15	(2)	20	17.6	8
Do	15	30	(1)	15.0	30
River Junction, Fla.	12	(2)	(1)	23.4	7
Flint:					
Albany, Ga.	20	4	9	26.2	5
Bainbridge, Ga.	25	7	10	27.7	8
Chattahoochee:					
Alaga, Ala.	30	1	6	35.0	5
Do	30	30	(1)	30.3	30
Alabama:					
Montgomery, Ala.	35	3	13	45.6	5
Selma, Ala.	35	(2)	16	48.8	7
Do	35	29	(1)	37.4	30
Coosa:					
Rome, Ga.	30	5	6	30.5	5
Gadsden, Ala.	22	2	14	27.4	10
Lock No. 4, Lincoln, Ala.	17	1	15	23.0	3
Wetumpka.	45	3	5	46.1	4
Etowah:					
Canton, Ga.	11	2	2	14.6	2
Oostanaula:					
Resaca, Ga.	25	3	7	32.0	4
Cahaba:					
Centerville, Ala.	25	2	2	26.6	2
Do	25	21	21	26.0	21
Tombigbee:					
Aberdeen, Miss.	33	4	5	34.7	4
Demopolis, Ala.	39	(2)	(1)	61.6	10
Black Warrior:					
Tuscaloosa, Ala.	46	2	7	61.3	3
Do	46	27	28	49.9	28

[1] Continued into May. [2] March.

Flood stages for the month of April, 1920—Continued.

River and station.	Flood stage.	Above flood stages—dates. From—	Above flood stages—dates. To—	Crest. Stage.	Crest. Date.
EAST GULF DRAINAGE—continued.					
Pearl:	*Feet.*			*Feet.*	
Edinburg, Miss.	21	5	6	22.4	5
Jackson, Miss.	20	(2)	21	29.0	11
Do	20	27	(1)	24.1	31
Columbia, Miss.	18	14	14	18.8	14
Do	18	29	(1)	21.7	30
West Pearl:					
Pearl River, La.	13	(2)	20	14.7	17
Do	13	28	(1)	13.4	28
GREAT LAKES DRAINAGE.					
Maumee:					
Fort Wayne, Ind.	15	21	26	21.5	23
Napoleon, Ohio.	10	23	23	10.2	23
St. Joseph:					
Montpelier, Ohio.	10	21	24	13.7	22
Auglaize:					
Defiance, Ohio.	10	23	23	11.0	23
Sandusky:					
Upper Sandusky, Ohio.	13	21	22	14.5	21
Tiffin, Ohio.	8	22	22	8.6	22
Fremont, Ohio.	10	22	23	12.4	22
MISSISSIPPI DRAINAGE.					
Ohio:					
Cincinnati, Ohio.	50	22	25	52.6	23
Louisville, Ky.	28	24	24	28.5	24
Cloverport, Ky.	40	23	29	44.3	25
Henderson, Ky.	33	24	(1)	39.1	28,29
Evansville, Ind.	35	23	(1)	40.8	28
Mount Vernon, Ind.	35	(2)	1	43.2	[2] 26
Do	35	24	(1)	40.5	29
Shawneetown, Ill.	35	(2)	2	46.0	[2] 27
Do	35	25	(1)	43.0	30
Cairo, Ill.	45	(2)	17	51.4	[2] 31
Do	45	25	(1)	49.2	30
Little Kanawha:					
Glenville, W. Va.	22	21	21	22.5	21
Muskingum:					
Zanesville, Ohio.	25	22	22	26.7	22
McConnelsville, Ohio.	22	21	24	25.7	22
Tuscarawas:					
Norris Point, Ohio.	8	18	24	11.7	22
Coshocton, Ohio.	8	17	24	14.6	22
Walhonding:					
Walhonding, Ohio.	8	17	23	12.0	21
Hocking:					
Athens, Ohio.	17	21	22	19.2	[2]
Scioto:					
Larue, Ohio.	11	17	23	14.5	21
Prospect, Ohio.	10	18	24	14.8	22
Bellpoint, Ohio.	9	17	17	10.4	17
Do	9	21	22	12.0	21
Dublin, Ohio.	8	21	21	8.5	21
Circleville, Ohio.	10	18	23	15.0	22
Chillicothe, Ohio.	14	19	24	20.6	23
Olentangy:					
Delaware, Ohio.	9	17	17	9.4	17
Do	9	21	22	11.6	22
Licking:					
Falmouth, Ky.	28	20	22	33.4	21
Miami:					
Sidney, Ohio.	12	21	21	12.8	21
Tadmor, Ohio.	13	21	22	15.5	21
Hamilton, Ohio.	12	21	22	14.1	21
Mad:					
Springfield, Ohio.	10	21	21	10.7	21
Stillwater:					
West Milton, Ohio.	7	21	22	12.7	21
Green:					
Lock No. 4, Woodbury, Ky.	33	3	7	37.4	5
Do	33	23	24	34.9	23
Lock No. 2, Rumsey, Ky.	34	25	(1)	35.5	29,30
Barron:					
Bowling Green, Ky.	20	2	4	25.0	4
Wabash:					
Bluffton, Ind.	12	18	22	12.9	19
Lafayette, Ind.	11	18	25	21.3	22
Terre Haute, Ind.	16	20	28	21.5	24
Vincennes, Ind.	14	23	(1)	20.0	26
Mount Carmel, Ill.	15	22	(1)	23.6	28,29
White:					
East Fork—					
Decker, Ind.	18	24	(1)	24.0	28
Shoals, Ind.	20	23	28	28.6	26
West Fork—					
Anderson, Ind.	12	21	22	13.2	21
Noblesville, Ind.	14	21	22	15.7	21
Elliston, Ind.	19	21	26	26.6	23
Cumberland:					
Carthage, Tenn.	40	4	5	42.8	4
Nashville, Tenn.	40	3	8	42.1	7
Clarksville, Tenn.	46	4	9	46.6	5
Lock D, Dover, Tenn.	49	6	10	49.7	8,9
Tennessee:					
Knoxville, Tenn.	12	2	5	26.7	3
Loudon, Tenn.	25	3	3	27.5	3
Chattanooga, Tenn.	33	3	7	43.6	5
Bridgeport, Ala.	24	4	8	29.2	6
Guntersville, Tenn.	31	3	11	38.8	8
Decatur, Ala.	21	5	11	23.1	9
Florence, Ala.	18	2	13	23.5	10
Riverton, Ala.	32	2	15	45.5	10
Savannah, Tenn.	40	4	15	46.7	12
Johnsonville, Tenn.	31	4	17	35.9	14

[3] Continued from March.

Flood stages for the month of April, 1920—Continued.

River and station.	Flood stage.	Above flood stages—dates. From—	To—	Crest. Stage.	Date.
MISSISSIPPI DRAINAGE—continued.					
French Broad:	*Feet.*			*Feet.*	
Penrose, N. C.	13	2	5	16.7	3
Asheville, N. C.	4	2	6	7.1	2
Dandridge, Tenn.	12	3	3	18.7	3
Big Pigeon:					
Newport, Tenn.	6	2	2	17.0	2
Holston:					
Rogersville, Tenn.	14	3	3	15.0	3
North Fork—					
Mendota, Va.	8	2	2	8.0	2
Clinch:					
Kingston, Tenn.	25	3	4	27.0	3
Little Tennessee:					
McGhee, Tenn.	20	2	3	30.5	2
Hiwassee:					
Charleston, Tenn.	22	2	5	30.5	3
Duck:					
Columbia, Tenn.	30	2	4	33.6	3
Mississippi:					
Winona, Minn.	16	(2)	1	16.0	1
La Crosse, Wis.	12	(2)	7	14.2	2
Prairie due Chien, Wis.	18	3	8	19.6	4,5
Dubuque, Iowa.	18	3	12	21.0	7
Clinton, Iowa.	16	6	15	19.0	8
Le Claire, Iowa.	10	4	17	13.4	9
Davenport, Iowa.	15	6	14	17.1	9
Muscatine, Iowa.	16	6	13	18.0	8
Keithburg, Ill.	12	5	20	14.2	10
Keokuk, Iowa.	14	3	25	16.8	11
Warsaw, Ill.	17	4	25	19.8	21
Quincy, Ill.	14	[2] 27	29	19.2	22
Hannibal, Mo.	13	(2)	(1)	19.5	22
Louisiana, Mo.	12	(2)	(1)	17.5	23
Grafton, Ill.	18	(2)	(1)	22.4	25
Alton, Ill.	21	(2)	(1)	25.1	24
Chester, Ill.	27	(2)	2	27.3	1
Cape Girardeau, Mo.	30	(2)	5	32.2	1,2
Do.	30	10	15	30.7	12
Do.	30	25	28	30.5	26
New Madrid, Mo.	34	(2)	21	40.2	1
Do.	34	24	(1)	37.9	30
Memphis, Tenn.	35	(2)	(1)	40.3	5
Helena, Ark.	42	(2)	(1)	50.1	8,9
Greenville, Miss.	42	4	(1)	47.0	16
Vicksburg, Miss.	45	4	(1)	50.8	19–28
Natchez, Miss.	46	9	(1)	51.5	28
Baton Rouge, La.	35	12	(1)	40.2	30
Donaldsonville, La.	28	13	(1)	31.5	28–30
New Orleans, La.	18	15	(1)	19.6	28–30
Arkansas City, Ark.	42	.....	.....	51.0	11
Wisconsin:					
Portage, Wis.	14	(2)	3	14.9	[2] 31
Des Moines:					
Ottumwa, Iowa.	10	20	21	12.0	21
Illinois:					
Morris, Ill.	13	19	26	17.8	21
Peru, Ill.	14	(2)	(1)	22.0	23
Henry, Ill.	7	(2)	(1)	16.2	24
Peoria, Ill.	16	(2)	(1)	22.9	25
Havana, Ill.	14	(2)	(1)	19.7	26–28
Beardstown, Ill.	12	(2)	(1)	21.3	27
Pearl, Ill.	12	(2)	(1)	19.1	27
Yazoo:					
Yazoo City, Miss.	25	2	(1)	30.8	27–30
Tallahatchie:					
Swan Lake, Miss.	25	16	(1)	28.7	30

[1] Continued into May. [2] March. [3] Continued from March

Flood stages for the month of April, 1920—Continued.

River and station.	Flood stage.	Above flood stages—dates. From—	To—	Crest. Stage.	Date.
MISSISSIPPI DRAINAGE—continued.					
Ouachita:	*Feet.*			*Feet.*	
Arkadelphia, Ark.	18	27	27	19.9	27
Camden, Ark.	30	(3)	3	33.8	[2] 31
Do.	30	29	(1)	35.1	30
Atchafalaya:					
Simmesport, La.	41	15	(1)	44.8	30
Melville, La.	37	8	(1)	41.6	30
Missouri:					
St. Charles, Mo.	25	9	10	25.2	10
Blairs, Nebr.	16	4	5	16.9	5
Pierre, S. Dak.	13	1	1	13.1	1
Grand:					
Chillicothe, Mo.	18	(3)	1	26.9	[2] 30
Do.	18	13	13	18.7	13
Do.	18	19	26	25.8	23
Brunswick, Mo.	10	(3)	10	11.6	8
Do.	10	20	27	10.8	21–25
Do.	10	30	(1)	10.3	30
James:					
Huron, S. Dak.	9	(3)	8	15.6	[2] 28
Petit Jean:					
Danville, Ark.	20	27	29	21.8	28
White:					
Newport, Ark.	26	(3)	1	29.3	[2] 29
Georgetown, Ark.	22	(3)	11	25.5	2
Black:					
Black Rock, Ark.	14	(3)	12	20.9	[2] 27
Sulphur:					
Finley, Tex.	24	(3)	2	28.0	[2] 29–30
Ringo Crossing, Tex.	20	27	29	21.2	27
WEST GULF DRAINAGE.					
Trinity:					
Trinidad, Tex.	28	(3)	6	36.7	2

[1] Continued into May. [2] March. [3] Continued from March.

MEAN LAKE LEVELS DURING APRIL, 1920.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., May 5, 1920.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes.[1] Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during April, 1920:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sea level at New York	602.26	580.54	571.64	245.55
Above or below—				
Mean stage of March, 1920	+0.34	+0.54	+0.79	+0.50
Mean stage of April, 1919	+0.26	−0.49	−1.41	−0.88
Average stage for April, last 10 years.	+0.62	+0.26	−0.76	−0.81
Highest recorded April stage	−0.43	−2.69	−2.54	−2.88
Lowest recorded April stage	+1.72	+1.32	+0.38	+0.71
Average relation of the April level to—				
March level	.....	+0.3	+0.6	+0.7
May level	.....	−0.3	−0.3	−0.3

[1] Lake St. Clair's level: In April, 574.80 feet.

EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, APRIL, 1920.

By J. WARREN SMITH, Meteorologist in Charge.

The weather during April was, on the whole, unfavorable for the growth of vegetation and for farm operations in nearly all sections of the country. Cool weather for the season persisted throughout the month in most central and northern districts, and rainfall was frequent in many sections, particularly between the Mississippi River and Appalachian Mountains and in the Southeast, resulting in soil conditions unfavorable for spring planting.

During the first decade of the month heavy rains fell from the lower Mississippi Valley eastward, and the planting of corn and cotton was further retarded in that area, owing to the continued saturated condition of the soil; these crops germinated rather poorly in Texas, necessitating considerable replanting. Winter wheat made some improvement, but it was too cool for best results, and the unfavorable weather in the spring-wheat belt caused considerable delay in the preparation of soil for seeding, although some seeding was done in the southern portion of the belt. The cold, stormy weather in the northwestern districts during the first decade of the month was very unfavorable for stock.

During the second decade, continued cool weather and saturated soil were unfavorable for farm operations in all central and northern districts, and also in most southern sections, and at the same time drought prevailed in the lower and west-central Great Plains. This period was too cool for cotton and corn and too wet in most sections, but winter wheat made fair advance in many districts, particularly in the Plains region. It continued unfavorable for seeding spring wheat, and that work was considerably delayed.

During the last decade of the month, the higher temperatures that prevailed in the Southern States were more favorable, and corn showed considerable improvement in germination and growth, while cotton planting made better advance than previously. Winter grains showed general, though mostly slow, advance during this period, although the improvement was substantial in the central Great Plains area. The weather continued cloudy, rainy, and cold in the spring-wheat belt and little progress in seeding could be made. The latter part of the month was more favorable for potatoes and truck crops in the southern States, but the planting of truck and gardens was delayed in central and northern districts on account of low temperatures and wet soil.